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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

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First Named Inventor or Application Identifier

CUNNINGHAM ET AL.

Express Mail Label No.	EL013384009US

J511 U.S. PTO
09/460197
12/13/99

APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents		**ADDRESS TO:**	Assistant Commissioner for Patents Box Patent Application Washington, DC 20231

1. ☑ Fee Transmittal Form   **2 sheets**
   (Submit an original, and a duplicate for fee processing)
2. ☑ Specification   [*Total Pages* **24**]
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. ☑ Drawing(s) *(35 USC 113)*   [*Total Sheets* **10**]
   (Formals)
4. Oath or Declaration   [*Total Pages* **3**]
   a. ☑ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37 CFR 1.63(d))
      (for continuation/divisional with Box 17 completed)
      [Note Box 5 below]
      i. ☐   <u>DELETION OF INVENTOR(S)</u>
         Signed statement attached deleting
         inventor(s) named in the prior application,
         see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference *(useable if Box 4b is checked)*
   The entire oath or declaration of the prior application, from which a
   copy of the oath or declaration is supplied under Box 4b,
   is considered as being part of the disclosure of the
   accompanying application and is hereby incorporated by
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6. ☐ Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission
   (if applicable, all necessary)
   a. ☐ Computer Readable Copy
   b. ☐ Paper Copy (identical to computer copy)
   c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement   ☐ Power of
   (when there is an assignee)   Attorney
10. ☐ English Translation Document *(if applicable)*
11. ☑ Information Disclosure   ☑ Copies of IDS
    Statement (IDS)/PTO-1449   Citations
12. ☐ Preliminary Amendment
13. ☑ Return Receipt Postcard (MPEP 503)
    (Should be specifically itemized)
14. ☐ Small Entity   ☐ Statement filed in prior application.
    Statement(s)   Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)
    (if foreign priority is claimed)
16. ☐ Other:_____
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    _____

17. If a **CONTINUING APPLICATION**, check appropriate box and supply the requisite information:

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18. CORRESPONDENCE ADDRESS

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR UNITED STATES PATENT

MULTIPLE AND HYBRID GRAPHICS DISPLAYS

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MULTIPLE AND HYBRID GRAPHICS DISPLAY TYPES

2

CROSS-REFERENCE TO RELATED APPLICATIONS

4   Not applicable.

6   **BACKGROUND OF THE INVENTION**

         The present invention relates to computer support of multiple display

8   types.

         Present computer systems provide a certain amount of flexibility in

10   combining multiple computer displays and display types to a single personal

     computer, workstation, or embedded system. For example, under the Microsoft

12   Windows 98 operating system, it is possible to simultaneously display images

     on two displays, but each display must be connected to a video adapter card

14   attached to an ISA or PCI bus via its own slot.   The computer must be

     configured (not in real time) to support the two different adapter cards and the

16   displays attached to them. Graphic libraries and drivers must be identified and

     employed for each output display type.   Different displays cannot be easily

18   swapped without extensive configuration.

         The following patents relate to the display portability problem addressed

20   above: U.S. Patent No. 5,960,213, to Wilson, entitled "Dynamically

     Reconfigurable Multi-Function PCI Adapter Device; U.S. Patent No. 5,948,091,

22   to Kerigan et al., entitled "Universal Digital Display Interface"; U.S. Patent No.

     5,910,180, to Flory et al., entitled "Context Virtualizing Device Driver

Architecture"; U.S. Patent No. 5,883,642, to Thomas et al., entitled

2 "Programmable Retargeter Method and Apparatus"; U.S. Patent No. 5,799,204,

to Pesto, Jr., entitled "System Utilizing BIOS-Compatible High Performance

4 Video Controller Being Default Controller at Boot-Up and Capable of Switching

to Another Graphics Controller After Boot-Up"; U.S. Patent No. 5,752,032, to

6 Keller et al., entitled "Adaptive Device Driver Using Controller Hardware Sub-

Element Identifier"; and U.S. Patent No. 5,606,657, to Dennison et al., entitled

8 "Virtual Graphics Processor for Embedded Real Time Display Systems".

However, unlike with the present invention, none of these solutions provide a

10 single display adapter than can simultaneously handle and switch between

multiple displays and display types.

12 Furthermore, the existence of both raster and stroke display types

renders it difficult to use raster-oriented graphics applications with stroke

14 display types. For example, VAPS formats, which are common in the industry,

are unable to drive stroke displays or to properly work with hybrid stroke/raster

16 displays in both modes. The following patents relate generally to this problem,

but none provide the ability of the present invention to drive stroke and hybrid

18 displays using VAPS formats: U.S. Patent No. 5,499,325, to Dugan, Jr., entitled

"Brightness Controls for Visual Separation of Vector and Raster Information";

20 U.S. Patent No. 4,635,050, to Grothe et al., entitled "Dynamic Stroke Priority

Generator for Hybrid Display"; U.S. Patent No. 4,631,532, to Grothe, entitled

22 "Raster Display Generator for Hybrid Display System"; and U.S. Patent No.

4,055,004, to Chase, entitled "Full Color Hybrid Display for Aircraft Simulators."

2 **SUMMARY OF THE INVENTION**

The following summary of the invention is provided to facilitate an

4 understanding of some of the innovative features unique to the present

invention, and is not intended to be a full description. A full appreciation of the

6 various aspects of the invention can be gained by taking the entire specification,

claims, drawings, and abstract as a whole.

8 The present invention is of a display interface device and method

comprising: providing one or more display interfaces connectable to a

10 computer bus of an individual personal computer, workstation, or embedded

system; providing a video library; and driving any one of a plurality of video

12 displays of a plurality of types connected to the one or more display interfaces

from output of the video library. In a preferred embodiment, the video library

14 comprises video library information, such as OpenGL information. Driving of

both stroke and raster display types can be done, as well as simultaneous

16 driving of stroke display(s) of different types or raster display(s) of same or

different types (e.g., FPD, HUD, MPD, MPCD, as shown in Fig. 8). Hybrid

18 stroke/raster displays can also be driven. The display interface can be provided

by a plurality of interface card mezzanines. Dynamic switching between

20 displays in real time is preferably employed.

The present invention is additionally of a device and method for driving

22 stroke displays using formats designed for raster displays (such as VAPS)

comprising: linking generated code from the formats to a standard graphics

library; and providing stroke video drivers that ignore raster masking. In a

2   preferred embodiment, linking is to an OpenGL library. The stroke video drivers

preferably use occlusion memory in place of raster masking. Both stroke and

4   raster displays can be driven and switching dynamically between them is

possible in real time.

6   The present invention is also of a device and method for driving multiple

displays of different types using formats designed for raster displays (such as

8   VAPS) comprising: linking generated code from the formats to a standard

graphics library; driving a plurality of displays of different types from output of

10   the graphics library; and dynamically switching between the displays in real

time. In a preferred embodiment, linking is to an OpenGL graphics library.

12   Driving is of both stroke and raster display types, and the stroke video drivers

are employed using occlusion memory in place of raster masking. Driving of

14   hybrid stroke/raster displays can be performed.

        The present invention is further of a device and method for driving a

16   hybrid stroke/raster display using formats designed for raster displays (such as

VAPS) comprising: linking generated code from the formats to a standard

18   graphics library; and providing stroke and raster display inputs from output of

the graphics library. In a preferred embodiment, linking is to an OpenGL

20   graphics library. The stroke video drivers preferably use occlusion memory in

place of raster masking. Dynamic switching can occur between stroke and

22   raster video drivers in real time.

A primary object of the present invention is to provide a single video

2   adapter interface that can drive multiple displays of the same, different, and/or

hybrid types.

4   Another object of the present invention is to provide the ability to drive

stroke displays using VAPS formats.

6   A further object of the present invention is to provide the ability to drive

hybrid stroke/raster displays using VAPS formats.

8   A primary advantage of the present invention is the greatly enhanced

portability of displays and display types between systems without extensive

10   reconfiguration required.

Another advantage of the present invention is that it promotes reusable

12   display formats and reduces the amount of testing needed to deploy graphics

software on new and different display types.

14   Other objects, advantages and novel features, and further scope of

applicability of the present invention will be set forth in part in the detailed

16   description to follow, taken in conjunction with the accompanying drawings, and

in part will become apparent to those skilled in the art upon examination of the

18   following, or may be learned by practice of the invention. The objects and

advantages of the invention may be realized and attained by means of the

20   instrumentalities and combinations particularly pointed out in the appended

claims.

22   The novel features of the present invention will become apparent to those

of skill in the art upon examination of the following detailed description of the

invention or can be learned by practice of the present invention. It should be

2 understood, however, that the detailed description of the invention and the specific

examples presented, while indicating certain embodiments of the present

4 invention, are provided for illustration purposes only because various changes and

modifications within the spirit and scope of the invention will become apparent to

6 those of skill in the art from the detailed description of the invention and claims

that follow.

8

BRIEF DESCRIPTION OF THE DRAWINGS

10 The accompanying figures, in which like reference numerals refer to

identical or functionally-similar elements throughout the separate views and which

12 are incorporated in and form part of the specification, further illustrate the present

invention and, together with the detailed description of the invention, serve to

14 explain the principles of the present invention.

Fig. 1 illustrates in hierarchical form the software running under the

16 invention on a General Purpose Processor (GPP; the workstation, personal

computer, or embedded system microprocessor) in combination with a

18 reconfigurable image processing module (IPM);

Fig. 2 further illustrates in hierarchical form the software running on an

20 IPM or equivalent hardware;

Fig. 3 illustrates an implementation of a user interface (in this case,

22 VAPS) to the video library of the invention;

Fig. 4 illustrates the data and control flow from the display task through

2   to the video driver outputs when code is employed to drive one or more displays

of one or more display types;

4   Figs. 5-7 are block diagrams of data and control flow through the low

level Application Programmer's Interface (API) graphic drivers to the displays in

6   different display and display type configurations;

Fig. 8 is a block illustration providing an overview of an implementation of

8   the video library of the invention and its relationships to the video hardware and

other software;

10   Fig. 9 is a block diagram demonstrating device driver switching in the

invention; and

12   Fig. 10 is a flow diagram for decision making concerning device driver

switching.

14

DETAILED DESCRIPTION OF THE INVENTION

16

The present invention provides the ability to, on a single workstation,

18   personal computer, or embedded system, and using a single interface card if

desired, drive multiple displays of different types and to dynamically switch

20   between them in real time. A commercial standard graphics library (such as

OpenGL) is employed together with dynamically switchable driver sets allowing

22   support of multiple displays of different types. The invention also provides the

ability to use raster-based display formats (such as VAPS) with stroke or hybrid

24   raster/stroke displays.

The present invention enhances reusability by enabling a single display

2   routine to drive a variety of output types without the necessity of creating

routine to drive a variety of output types without the necessity of creating

4   graphics library to create the display routine and tailoring the specific driver

functions to work with the graphics library, as well as requiring all graphic

6   interface to be through the graphics library, all hardware modes are isolated to

the device drivers. Device drivers can then be created and modified to match

8   the output without changing the display routine interface. The device driver set

necessary to drive the varying output type is associated with each graphic

10   context. When a graphic context is switched, the drivers are switched and a

different output can be displayed to. The drivers can be switched dynamically,

12   which makes multiple simultaneous outputs possible. This also allows for the

support of hybrid modes in which multiple drivers can operate for the same

14   output and drive raster and stroke on the same display if that display is capable.

The architecture conveniently supports multiple displays, various modes (e.g.,

16   stroke and raster), and future display types and hardware that may be

developed. A common software platform is thereby created that can be used

18   transparently for a wide range of hardware and software applications. As an

example, development of and modifications to graphics intensive operational

20   flight program software are greatly enhanced by the present invention.

The invention also enhances reusability by permitting the same VAPS

22   frame to be used to create display pages for both raster and stroke displays that

will look the same. Again, a commercial standard graphics library is employed

for linking the VAPS generated code to the display drivers. Accommodations

2 are made in the stroke drivers to ignore masking that is used by raster displays

and allow for the same effect by using occlusion memory for the stroke display.

4 A new graphics context is used for each virtual CRT as well as treating each

virtual CRT as a root CRT to get proper scaling. Each graphic context is tied to

6 a specific output driver set, and hybrid mode can be used with VAPS by

switching output drivers within a graphics context. Multiple outputs are also

8 enabled in this manner by creating additional virtual CRTs using different device

drivers.

10 The software preferably employed in the embodiment of the invention

employing an image processing module manufactured by Honeywell (IPM; e.g.,

12 a single VME card having a plurality of mezzanines for connection to a plurality

of displays) includes a Real-Time Operating System (RTOS) such as VxWorks,

14 the Tornado development environment, the OpenGL graphics language, and

the Visual Applications Builder (VAPS) display format development tool. Fig. 1

16 illustrates in block form the software running both on a General Purpose

Processor (GPP; the workstation, personal computer, or embedded system

18 microprocessor) and on the IPM. Shaded areas indicate reusable software.

Fig. 2 provides additional detail. Figs. 5-7 are block diagrams of data and

20 control flow through the low level API graphic drivers to the displays in different

display and display type configurations. Low level API pointers to the display's

22 raster or stroke drivers are preferably initialized only once during power-on

initialization. Fig. 3 illustrates an implementation of a user interface (in this

2   case, VAPS) to the video library.

The present invention also permits the same VAPS frame to drive both

4   stroke and raster displays. A commercial standard graphics library (e.g.,

OpenGL) links VAPS generated code to the display drivers to do either raster or

6   stroke. The stroke display drivers are preferably modified to ignore raster

masking and to use occlusion memory instead. Fig. 4 illustrates the data and

8   control flow from the display task through to the video driver outputs.

Hybrid displays can be driven from VAPS generated code as well as

10   multiple displays. VAPS was designed to drive a single raster output display,

but the present invention permits it to go beyond that limitation. The VAPS

12   portkit is modified to create a new graphics context for each virtual CRT. Each

virtual CRT is treated as a root CRT in order to achieve proper scaling. A

14   commercial standard graphics library (e.g., OpenGL) links the VAPS generated

code to the display drivers and each graphic context is tied to a specific output

16   driver set. Hybrid mode is rendered possible by switching output drivers within

a graphics context. Multiple outputs are rendered possible by creating

18   additional virtual CRTs using different device drivers.

Preferred design descriptions for the software of the invention next

20   follow:

Referring to Fig. 8, the preferred Video Library is a software interface for

22   graphics hardware that allows programs that use it to produce high quality

graphic images. The library allows a standard commercial interface to be able

to drive a variety of output types. The Video Library preferably comprises a

2   graphics module which contains Graphics Library Utility Tools (GLUT) and

OpenGL functions, a video control module which contains video functions that

4   are not handled by the graphics module, and a device drivers module which

communicates directly with the hardware. The device drivers are the functions

6   that can be replaced to match the targeted hardware. Multiple drivers can be

used simultaneously.

8   The video control module is a set of functions that are needed for the

image processing module that can not be accomplished using the Open GL

10   libraries or the GL utility tool kit. This supports functions that are common

among the drivers. Preferred data structures include: display, context, driver,

12   and hybrid mode control, and hardware specific interfaces.

           The graphics library includes a subset of Open GL functions and Open

14   GL utility tool kit functions.

           A subset of the GLUT kit library is preferably implemented for the image

16   processing module of the invention. This library contains the functions

necessary to initialize the display and setup the windows to put graphics in.

18   This library follows the functional description of the GLUT API. The preferred

data structures employed include the following: contexts initialization, context

20   switching (device drivers switched with context), swapping buffers, color

palettes control, animation control, and window state retrieval.

22   Referring to Figs. 9 and 10, the low level functions are the interface to

the device drivers that get swapped out depending on the output that is being

used. These calls are made by video control and graphics libraries and are not

2 called directly by the display program.

The Graphics Library is intended to provide the only interface to the low

4 level graphic drivers. The graphics library includes a subset of Open GL functions, Open GL utility functions, and Open GL utility tool kit functions.

6 The detailed descriptions for the preferred API GL Utility Functions are specified: inOpenGL Programming for the X Window System, Mark J. Kilgard,

8 Addison-Wesley, ISBN 0-201-48359-9.

The detailed descriptions for the preferred API OpenGL functions are

10 specified in: OpenGL Reference Manual, Second Edition, Addison-Wesley, ISBN 0-201-46140-4.

12 In summary, the present invention provides the ability to, on a single workstation, personal computer, or embedded system, and using a single

14 interface card if desired, drive multiple displays of different types and to dynamically switch between them in real time. Raster-based display formats

16 (such as VAPS) can also be used with stroke or hybrid raster/stroke displays. The invention thereby enhances reusability by enabling a single display routine

18 to drive a variety of output types without the necessity of creating separate display routines for each output type. The architecture conveniently supports

20 multiple displays, various modes (e.g., stroke and raster), and future display types and hardware that may be developed. A common software platform is

22 thereby created that can be used transparently for a wide range of hardware and software applications.

The embodiments and examples set forth herein are presented to best

2   explain the present invention and its practical application and to thereby enable

those skilled in the art to make and utilize the invention. Those skilled in the art,

4   however, will recognize that the foregoing description and examples have been

presented for the purpose of illustration and example only. Other variations and

6   modifications of the present invention will be apparent to those of skill in the art,

and it is the intent of the appended claims that such variations and modifications

8   be covered. The description as set forth is not intended to be exhaustive or to

limit the scope of the invention. Many modifications and variations are possible

10   in light of the above teaching without departing from the spirit and scope of the

following claims. It is contemplated that the use of the present invention can

12   involve components having different characteristics. It is intended that the scope

of the present invention be defined by the claims appended hereto. The entire

14   disclosures of all references, applications, patents, and publications cited above

are hereby incorporated by reference.

<u>**CLAIMS**</u>

The embodiments of an invention in which an exclusive property or right is claimed are defined as follows:

2   1.   A display interface device for an individual personal computer, workstation, or embedded system, said device comprising:

4   one or more display interface means connectable to a computer bus of said individual personal computer, workstation, or embedded system;

6   means for storing video library information; and

               a plurality of means for driving any one of a plurality of video

8 displays of a plurality of types connected to said one or more display interface means from output of said video library.

2.   The device of Claim 1, wherein said video library information is OpenGL video library information.

3.   The device of Claim 1, wherein said plurality of driving means comprises means for driving both stroke and raster display types.

4.   The device of Claim 1, wherein said plurality of driving means comprises means for simultaneously driving stroke displays of different types.

5.   The device of Claim 1, wherein said plurality of driving means comprises means for simultaneously driving raster displays of different types.

6.   The device of Claim 1, wherein said plurality of driving means comprises means for driving hybrid stroke/raster displays.

7.   The device of Claim 1, wherein said one or more display interface means comprises a plurality of interface card mezzanines.

8.   The device of Claim 1 further comprising means for dynamically switching between displays.

9.   The device of Claim 8, wherein said switching means operates in real time.

10.   A display interface method comprising the steps of:

providing one or more display interface means connectable to a computer bus of an individual personal computer, workstation, or embedded system;

providing a video library; and

driving any one of a plurality of video displays of a plurality of types connected to the one or more display interface means from output of the video library.

11.   The method of Claim 10, wherein the step of providing a video library comprises providing a video library comprising OpenGL video library information.

12.   The method of Claim 10, wherein the driving step comprises driving both stroke and raster display types.

13.   The method of Claim 10, wherein the driving step comprises simultaneously driving stroke displays of different types.

14.   The method of Claim 10, wherein the driving step comprises simultaneously driving raster displays of different types.

15.   The method of Claim 10, wherein the driving step comprises driving hybrid stroke/raster displays.

16.   The method of Claim 10, wherein the step of providing one or more display interface means comprises providing a plurality of interface card mezzanines.

17.   The method of Claim 10 further comprising the step of dynamically switching between displays.

18.   The method of Claim 17, wherein the dynamic switching step operates in real time.

2   19.   A device for driving stroke displays using formats designed for raster displays, said device comprising:

4   means for linking generated code from said formats to a standard graphics library; and

6   stroke video drivers that ignore raster masking.

20.   The device of Claim 19, wherein said formats are VAPS formats.

21.   The device of Claim 19, wherein said standard graphics library comprises an OpenGL library.

22.   The device of Claim 19, wherein said stroke video drivers use occlusion memory.

23.   The device of Claim 19 further comprising means for driving both stroke and raster displays.

24.   The device of Claim 23 further comprising means for dynamically switching between stroke and raster displays.

25.   The device of Claim 24, wherein said switching means operates in real time.

2   26.   A method for driving stroke displays using formats designed for raster displays, the method comprising the steps of:

4   linking generated code from the formats to a standard graphics library; and

6   providing stroke video drivers that ignore raster masking.

27.   The method of Claim 26, wherein the linking step comprises linking VAPS generated code.

28.   The method of Claim 26, wherein the linking step comprises linking to an OpenGL library.

29.   The method of Claim 26, wherein the providing step comprises providing stroke video drivers use occlusion memory rather than raster masking.

30.   The method of Claim 26 further comprising the step of driving both stroke and raster displays.

31.   The method of Claim 30 further comprising the step of dynamically switching between stroke and raster displays.

32.   The method of Claim 31, wherein the switching step operates in real time.

2   33.   A computer device for driving multiple displays of different types using formats designed for raster displays, said device comprising:

4   means for linking generated code from said formats to a standard graphics library;

6   means for driving a plurality of displays of different types from output of said graphics library; and

8   means for dynamically switching between said displays in real time.

34.   The device of Claim 33, wherein said graphics library comprises an OpenGL graphics library.

35.   The device of Claim 33, wherein said formats are VAPS formats.

36.   The device of Claim 33, wherein said driving means comprise stroke video drivers using occlusion memory.

37. The device of Claim 33, wherein said driving means comprises means for driving hybrid stroke/raster displays.

2 38. A computer device for driving a hybrid stroke/raster display using formats designed for raster displays, said device comprising:

4 means for linking generated code from said formats to a standard graphics library; and

6 means for providing stroke and raster display inputs from output of said graphics library.

39. The device of Claim 38, wherein said graphics library comprises an OpenGL graphics library.

40. The device of Claim 38 further comprising stroke video drivers using occlusion memory.

41. The device of Claim 38 further comprising means for dynamically switching between stroke and raster video drivers in real time.

42. The device of Claim 38, wherein said formats are VAPS formats.

2 43. A method for driving multiple displays of different types using formats designed for raster displays, the method comprising the steps of:

linking generated code from the formats to a standard graphics

2   library;

driving a plurality of displays of different types from output of the

4   graphics library; and

dynamically switching between the displays in real time.

44.   The method of Claim 43, wherein the linking step comprises linking to an OpenGL graphics library.

45.   The method of Claim 43, wherein the linking step comprises linking VAPS generated code.

46.   The method of Claim 43, wherein the driving step comprises employing stroke video drivers using occlusion memory rather than raster masking.

47.   The method of Claim 43 wherein, the driving step comprises driving hybrid stroke/raster displays.

2   48.   A method for driving a hybrid stroke/raster display using formats designed for raster displays, the method comprising the steps of:

4   linking generated code from the formats to a standard graphics library; and

providing stroke and raster display inputs from output of the

2   graphics library.

49.   The method of Claim 48, wherein the linking step comprises linking to an OpenGL graphics library.

50.   The method of Claim 48 further comprising the step of providing stroke video drivers using occlusion memory.

51.   The method of Claim 48 further comprising the step of dynamically switching between stroke and raster video drivers in real time.

52.   The method of Claim 51, wherein the linking step comprises linking VAPS generated code.

ABSTRACT OF THE DISCLOSURE

2   A display interface device and method for an individual personal computer, workstation, or embedded system comprising one or more display

4   interfaces; a video library; and driving any one of a plurality of video displays of a plurality of types connected to the one or more display interfaces from output

6   of the video library. OpenGL is a preferred API. Driving of hybrid displays as well as stroke displays using formats designed for raster displays (such as

8   VAPS) is also provided for. Real-time switching between displays is also provided for.
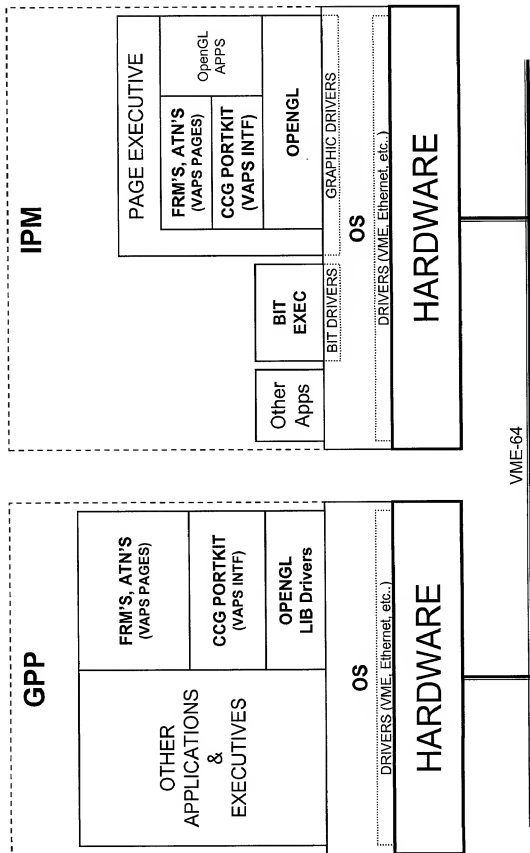
FIG. 1
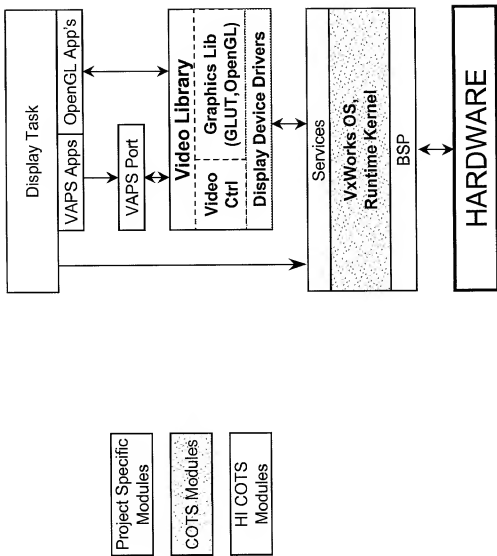
FIG. 2
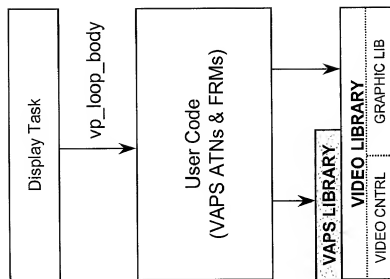
FIG. 3
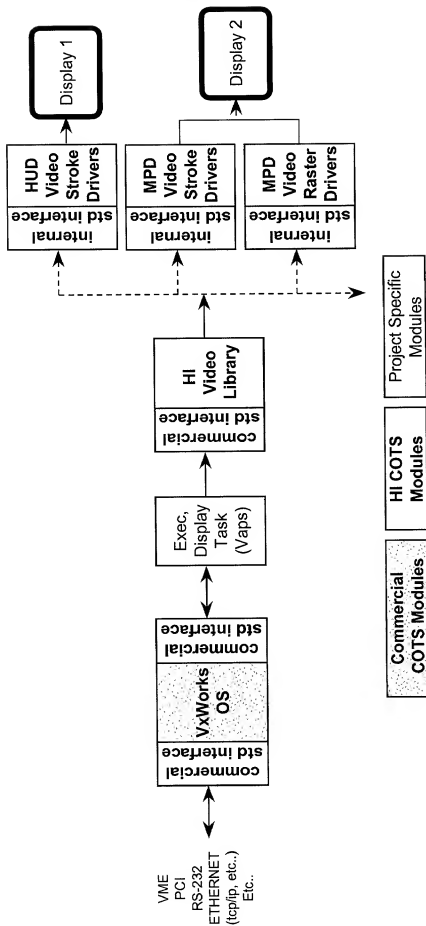
FIG. 4
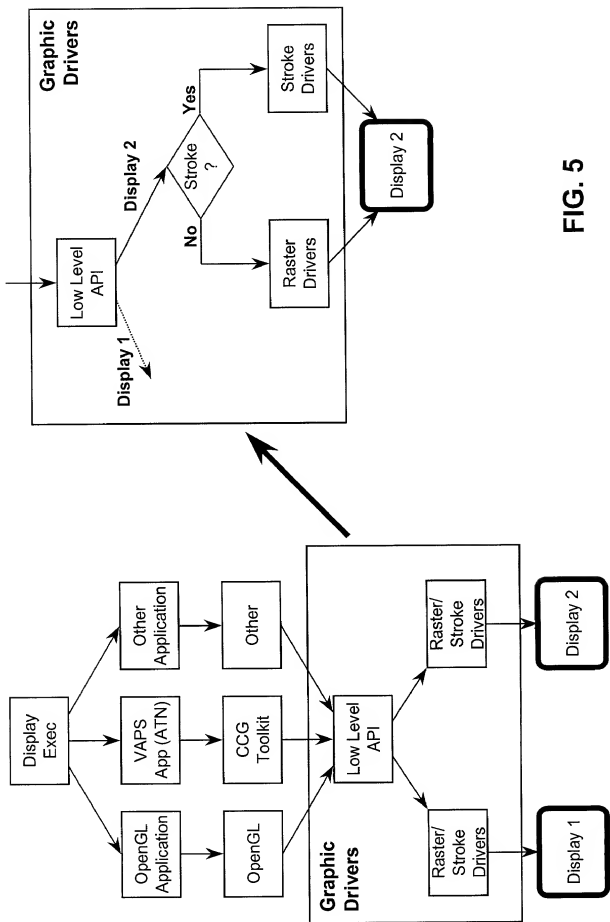
FIG. 5
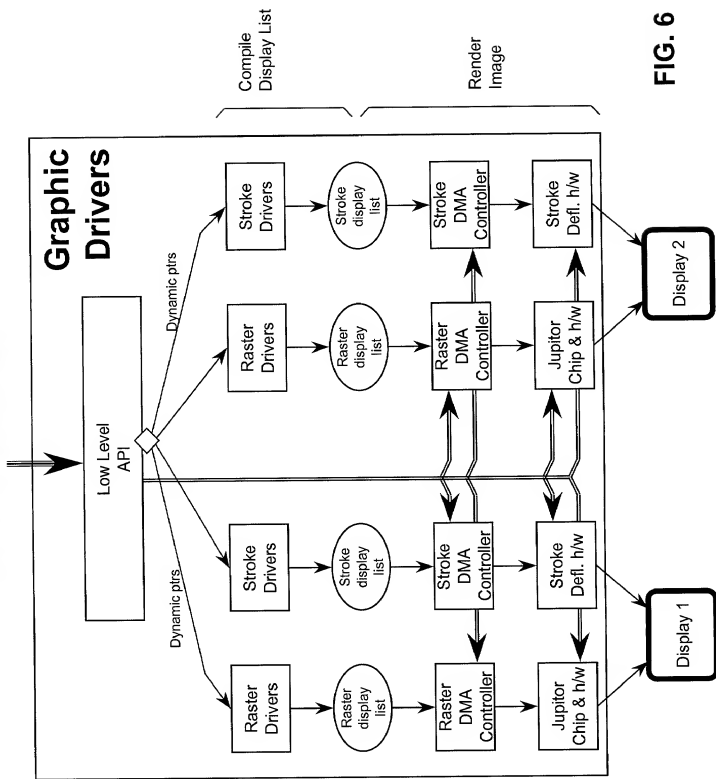
FIG. 6
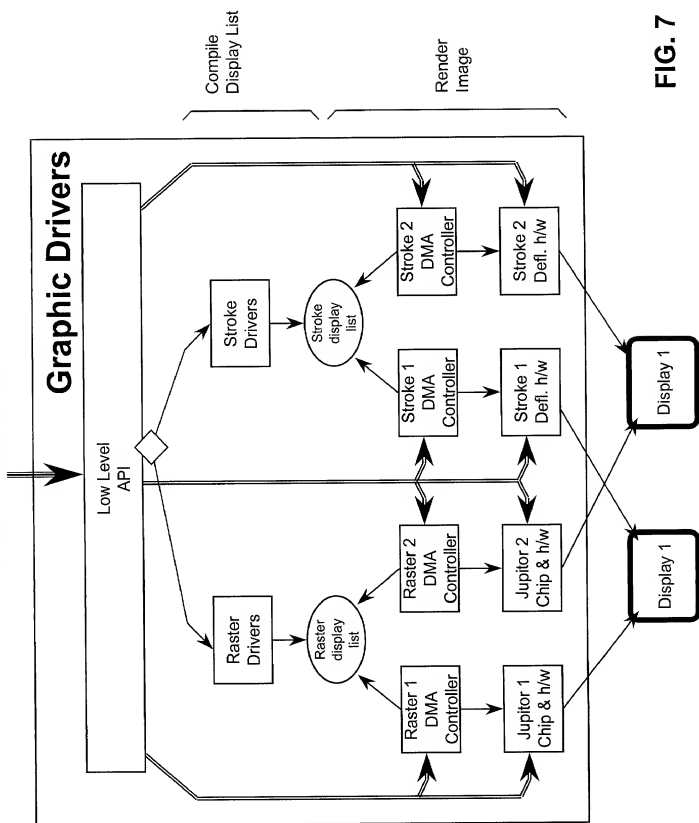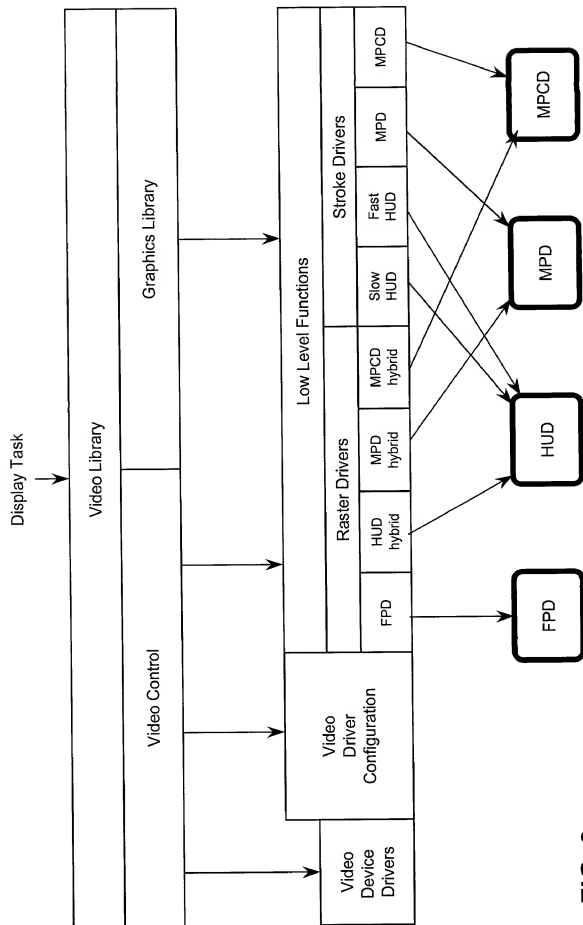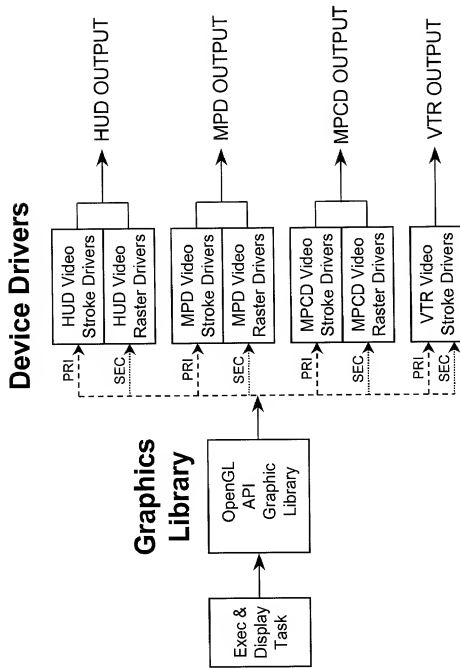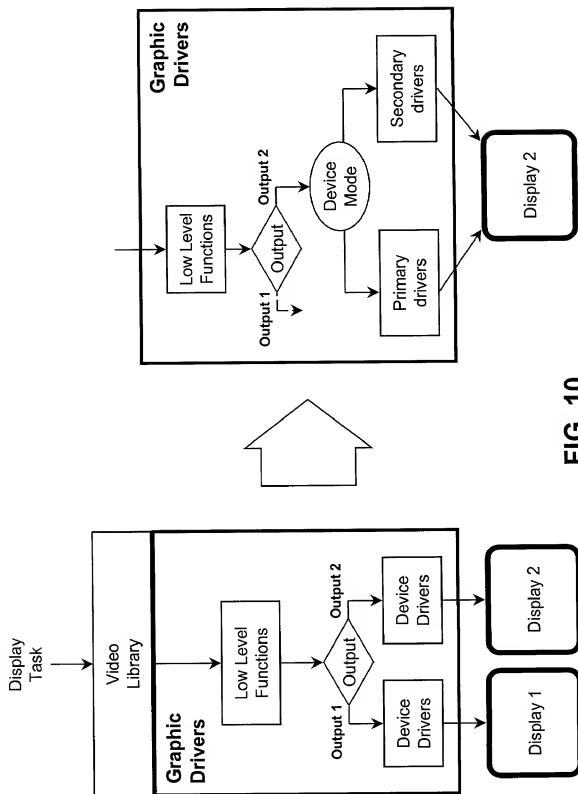
Graphic Drivers

Low Level API

Compile Display List

Render Image

Raster Drivers

Stroke Drivers

Raster display list

Stroke display list

Raster 1 DMA Controller

Raster 2 DMA Controller

Stroke 1 DMA Controller

Stroke 2 DMA Controller

Jupitor 1 Chip & h/w

Jupitor 2 Chip & h/w

Stroke 1 Defl. h/w

Stroke 2 Defl. h/w

Display 1

Display 1

FIG. 7

FIG. 8

FIG. 9

FIG. 10

A65-25311

DECLARATION FOR UTILITY OR DESIGN
PATENT APPLICATION
(37 CFR 1.63)

☑ Declaration Submitted with Initial Filing

OR

☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	**A65-25311**
First Named Inventor	**Cunningham et al.**
COMPLETE IF KNOWN	
Application Number	/
Filing Date	**December 13, 1999**
Group Art Unit	**New Application**
Examiner Name	**New Application**

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MULTIPLE AND HYBRID GRAPHICS DISPLAYS

(Title of the Invention)

the specification of which
☑ is attached hereto
OR
☐ was filed on (MM/DD/YYYY) [   ] as United States Application Number or PCT International

Application Number [   ] and was amended on (MM/DD/YYYY) [   ] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

[Page 1 of 2]

A65-25311

Please type a plus sign (+) inside this box → ☐ +

DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: X☐ Customer Number [000128] → ☐ Place Customer Number Bar Code Label here.
X OR
X Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

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☒ Additional inventors are being named on the 1 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

[Page 2 of 2]

Please type a plus sign (+) inside this box → +

DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page 1 of 1

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Residence: City	State	Country		Citizenship

Post Office Address

Post Office Address

| City | State | ZIP | Country |